REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	4/15/2002	Final Report October, 2000 – December, 2001

4. TITLE AND SUBTITLE
An Innovative Investigation of Productivity Estimation & Performance Assessment

5. FUNDING NUMBERS
N000140110092

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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of Naval Research

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution Unlimited

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

The objective of this research was to investigate innovative methods for selecting appropriate performance measures for job tasks. In the framework developed by this research, jobs are considered to consist of demands, which are met by the worker using skills that make use of that worker's physical and cognitive resources. Performance measures can be used to evaluate an individual's cognitive and physical resources in a given domain. Performance concerns within a job typically include 1) Error/Accuracy, 2) Time/Productivity, 3) Workload, 4) Job Preference/Satisfaction, and 5) Training. The procedure for matching performance measures to jobs involves 4 steps: 1) Categorize performance measures of interest into the five performance concern areas, 2) Define which human abilities are evaluated by each performance measure, 3) Determine which human abilities are utilized by workers to complete a particular job task, and 4) Use the human abilities to match potential performance measures to the job

14. SUBJECT TERMS	15. NUMBER OF PAGES
Job performance evaluation, productivity	5
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

FINAL TECHNICAL REPORT

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INSTITUTION: Mississippi State University

GRANT TITLE: An Innovative Investigation of Productivity Estimation & Performance Assessment

AWARD PERIOD: October, 2000 – December, 2001

OBJECTIVE: To investigate innovative methods for selecting appropriate performance measures for job tasks.

APPROACH: After extensive literature review a theoretical framework for job performance evaluation was developed. In this theoretical framework, jobs are considered to consist of specific demands, which are met by the worker using skills that make use of that worker's physical and cognitive resources. Performance concerns within a job typically include 1) Error/Accuracy/Quality, 2) Time/Productivity, 3) Workload – both physical and cognitive, 4) Job Preference/Satisfaction/Morale, and 5) Training. Existing performance measures can be used to evaluate an individual's cognitive and physical resources See Fleishman, E. A. and Reilly, M.E. (1995). Handbook of Human Abilities. Potomac Maryland: Management Research Institute, Inc., Publishers for a discussion of performance measures for a fundamental set of human abilities.

The procedure for matching performance measures to jobs involves 4 steps:

1. Categorize performance measures of interest into the five performance concern areas.
2. Define which human abilities are evaluated by each performance measure
3. Determine which human abilities are utilized by workers to complete a particular job task
4. Use the human abilities to match potential performance measures to the job

ACCOMPLISHMENTS

Step 1 involves developing a database of performance measures. In this database each of the performance measures is matched to one or more of the performance concerns listed above. Performance measures for this database may come from references such as Gawron, V.J. (2000). Human Performance Measures Handbook. Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers, or they may come from job-specific or industry-specific sets of performance measures. Each performance measure is evaluated based on previous literature on the measure as well as expert judgment as to its appropriateness in evaluating each of the performance concerns – error, time, workload, job preference, and/or training. An example of several entries from this type of database

follows. (This example is not a comprehensive list of all potential performance measures.):

Performance Measure	Accuracy/Error/Quality	Time/Speed/Rate	Production	Physical Workload	Mental Workload	Training	Preference/Motivation/Morale
number correct	1	0	0	0	0	0	0
number of errors	1	0	0	0	0	0	0
error rate	1	0	0	0	0	0	0
output per unit time	0	1	1	0	0	0	0
output per unit input	0	0	1	0	0	0	0
Borg RPE	0	0	0	1	0	0	0
Modified Cooper-Harper	0	0	0	0	1	0	0
Profile of Mood States	0	0	0	0	0	0	1
Employee Attrition	0	0	0	0	0	0	1

Step 2 involves developing a database of physical and cognitive human abilities. In this database each of the human abilities is matched to one or more of the five performance concerns listed above. This database indicates if a given human ability can be evaluated with performance measures of each type. Lists and operational definitions of human abilities may be derived from sources such as Fleishman, E. A. and Quaintance, M.K. (1984). Taxonomies of Human Performance; The Description of Human Tasks. Potomac Maryland: Management Research Institute, Inc., Publishers. An example of several entries from this type of database follows (This example is not a comprehensive list of all human abilities.):

Human Ability	Accuracy/Error/Quality	Time/Speed/Rate	Production	Physical Workload	Mental Workload	Training	Preference/Motivation/Morale
Oral comprehension	1	0	0	0	1	0	0
Written comprehension	1	0	0	0	1	0	0
Originality	1	0	0	0	1	0	1
Memorization	1	0	0	0	1	0	0
Reaction Time	0	1	0	1	0	0	0
Arm-Hand Steadiness	0	0	0	1	0	0	0
Manual Dexterity	0	1	1	1	0	0	0
Explosive Strength	0	0	0	1	0	0	0
Dynamic Strength	0	0	0	1	0	0	0
Trunk Strength	0	0	0	1	0	0	0
General Vision	1	0	0	0	0	0	0
Near Vision	1	0	0	0	0	0	0
Far Vision	1	0	0	0	0	0	0

Step 3 involves using a questionnaire to elicit information on which human abilities are used in a given job of interest. This information may be elicited from personnel familiar with the job or it may be extracted from detailed textual job descriptions by searching for keywords related to the human abilities. It may be useful for these purposes to elicit more general job requirements such as pushing, pulling, walking, seeing, etc… and then use these general terms to derive the specific human abilities that are required to successfully perform that general job requirement.

Step 4 matches performance measures to jobs using the human abilities and the performance concerns as intermediary steps. This step would be performed by a computer running a matching algorithm.

As an example, It may be determined for a given job of interest that the job requires the worker to possess high degrees of the human abilities of written comprehension and memorization in order to complete the task properly. Then, using the matrix detailed in step 2, we determine that it is possible to evaluate these two human abilities in terms of accuracy and mental workload. This information is then used to reference the matrix detailed in step 1 in order to generate a set of performance measures appropriate for the job of interest. In this case, it would be determined that the worker's performance of this particular job could be evaluated using the number correct, number of errors, error rate, or modified Cooper-Harper techniques.

CONCLUSIONS: Using this theoretical framework and 4-step method, it is possible to select appropriate performance measures for a given job task based on strengths and weaknesses of the various performance measures, the worker's physical and cognitive resources, and the requirements of the job task.

SIGNIFICANCE: This research effort has broad applicability to all branches of the military as well as the industrial sector. The research conducted under this project will serve as a methodology that may be duplicated to accomplish goals of productivity estimation and performance assessment of various jobs and/or job task.

PATENT INFORMATION: None

AWARD INFORMATION: None

REFEREED PUBLICATIONS (for total award period): None

BOOK CHAPTERS, SUBMISSIONS, ABSTRACTS AND OTHER PUBLICATIONS:

Crumpton-Young, Soh, and Parker (2002). A Brief Review on Human Performance: Task and Measurements. (manuscript in preparation).

Crumpton-Young, Soh, and Parker (2002). An Algorithm for Determination of Appropriate Performance Measures for Job Tasks. (manuscript in preparation).